AIR NAVIGATION

LESSON 1: GETTING THERE BY AIR

PURPOSE

For centuries, people dreamed of flying like birds. They told stories of flying beings and designed flying contraptions that remained earthbound. In 1903, the Wright brothers made human flight a reality, and today air flight is a common occurrence. Aircraft are used to transport cargo as well as people. We "fly" for recreation as well as business. Travel by air brings almost every part of the world physically within your reach in far less time than travel by car, train, or boat.

This lesson will give you a glimpse into the world of flight by teaching you about air navigation and flight execution. It will boost your map reading skills and point out the differences between getting there on the ground and flying there in the air.

altimeter
cultural features
Greenwich Mean Time
hydrographic features
linear features
nautical mile
pilotage
preflight
prime meridian
statute mile

INTRODUCTION

As you discovered in previous *Map Reading* lessons, when you travel on foot, you have to consider the terrain. Where is the best place to cross a stream? Do you walk over a hill or around it? How long will it take to get there if the ground level keeps rising and falling? Likewise, travel by car depends on the roads leading to your destination, which in turn maneuver around natural and man-made features. Very rarely can you travel in a straight line on the ground from your departure point to your destination.

Air travel, however, is different. Without the limitations of terrain, you determine your heading and fly in a straight line from point A to point B. Of course, as with ground navigation, you must plan your trip carefully; and once in the air, you must follow your route and keep alert. You may be free from terrain difficulties in the sky, but flying comes with its own set of rules.

AIR NAVIGATION CHARTS

Assume you live in Alexander City, Alabama, and during spring break you want to attend a race at the Talladega International Speedway in Talladega, Alabama. You have your private pilot's license and an available airplane. Before you can begin planning your trip, you need to find the proper map. The information found on topographic and road maps, such as trail markers, building symbols, highway route numbers, and points of interest, will be of little help when flying at 6,000 feet.

Also, road or topographic maps do not depict information about radio aids and tall towers. You need a map designed for air navigation, specifically an aeronautical chart that will show landmarks to aid you in navigating to Talladega.

DID YOU KNOW?

You may use the words "chart" and "map" interchangeably, but most professional navigators refer to maps as charts.

CHART SCALES

Not all aeronautical charts are the same. The pilot of a light aircraft flies low enough to navigate by landmarks identifiable from the air. An airline pilot, however, is only near enough to the ground to navigate by landmarks on take-offs and landings. Therefore, the light plane pilot and the airline pilot need to use different charts with different scales.

Remember, when it comes to charts, covering a large area means using a small scale, while covering a small area means using a large scale. Since you are flying within the state of Alabama, you will use a large scale chart that shows more detail of a small area. An airline pilot crossing the U.S. would use a small scale chart covering a large area.

As discussed in previous *Map Reading* lessons, the scale of a chart may be given as a representative fraction. For example, 1:500,000 indicates that one unit on a chart equals 500,000 units of the same measure on the ground. The most common unit of measure for distance in air navigation is the **nautical mile**.

To understand the size of a nautical mile, recall that you can divide each degree of latitude and longitude into 60 minutes. A nautical mile is one minute of latitude or approximately 6,080 feet — slightly larger than the **statute mile** used in road travel in the U.S., which is 5,280 feet. Since a nautical mile is one minute of latitude, there are an even 60 nautical miles in one degree of latitude. This makes navigating long distances with the nautical mile easier than with the statute mile.

JET NAVIGATION (JN) CHART

The JN has a scale of 1:2,000,000 or one inch to 27.4 nautical miles. Pilots flying long-range, high-speed aircraft use the JN which details **hydrographic** and **cultural features** identifiable from high altitudes.

OPERATIONAL NAVIGATION CHART (ONC)

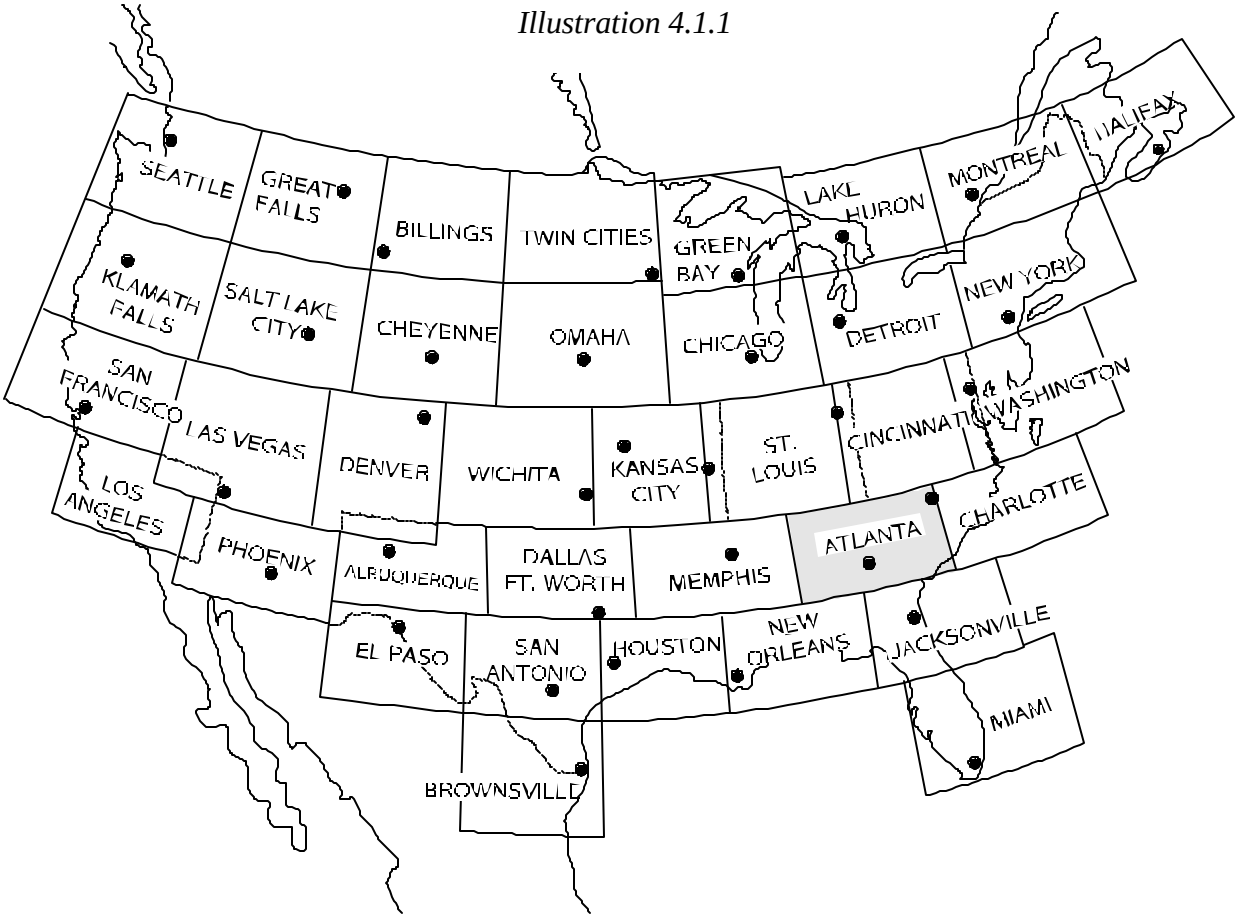
The ONC has a scale of 1:1,000,000 or one inch to 13.7 nautical miles. Since it covers less area on a single chart than the JN, it shows more detail of hydrographic and cultural features. Pilots flying higher-speed aircraft use the ONC for medium- and some low-level navigation.

SECTIONAL AERONAUTICAL CHART

The sectional aeronautical chart has a scale of 1:500,000. It is the largest scale of the three charts discussed here, and therefore shows even more detail of hydrographic and cultural features. It provides excellent ground details for visual ground-chart orientation and depicts navigation aids and air facilities. The sectional aeronautical chart is the basic aeronautical chart of the U.S., and because of its scale and detail, is the chart you choose for your flight.

Since sectional aeronautical charts cover small areas, there are 37 that make up the continental U.S. You must choose which one to use. In the following illustration, you can see that the Atlanta Sectional covers Alabama and

Illustration 4.1.1



is the appropriate chart for your trip. It gives enough details of the ground for you to navigate using visual landmarks from Alexander City to Talladega. This type of landmark flying, called **pilotage,** is the basic method of light plane navigation in good weather.

PREFLIGHT

There are several responsibilities to tend to before any flight. Since these occur before your actual flight, they are generally referred to as **preflight**. As with any hike or road trip you undertake, how well you plan, or preflight, will directly affect how successful and enjoyable your flight is. Preflight activities include:

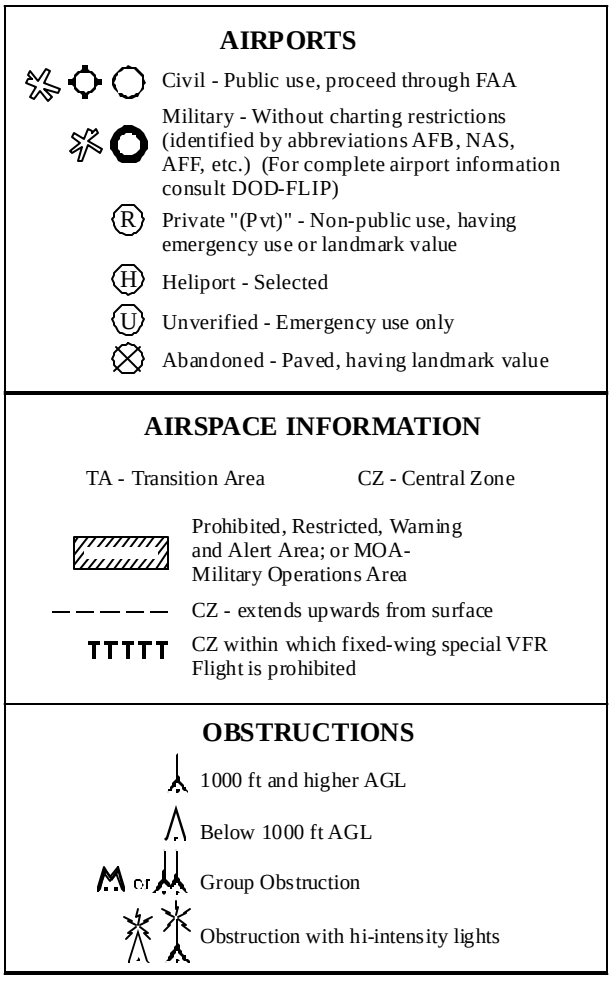
- choosing and studying the appropriate charts
- planning your flight route
- checking the weather
- checking the aircraft
- filing a flight plan.

STUDYING THE APPROPRIATE CHARTS

As discussed in previous *Map Reading* lessons, around the edge of a map are marginal (title) information, relief data, and other symbols that make up the legend. This is also true of aeronautical charts. Check the title information on your chart first, noting that you have the right sectional and, most importantly, that the chart is not obsolete. Never use an obsolete chart for flying! Running into a new tower not plotted on an old chart can ruin a trip.

Next, familiarize yourself with the aeronautical symbols used on the chart. In the illustration below, note the examples of symbols you may not find on a topographic or road map.

Illustration 4.1.2



Read the list of prohibited, restricted, warning, and alert areas included on your chart. This list explains restrictions that apply to designated areas and who is responsible for the areas. For example, altitude is restricted to 5,000 feet over Anniston Army Depot, Alabama, from 0700 to 1800 Monday through Friday under the authority of the CO, Anniston Army Depot. If your flight path crosses any of those areas, make note of what altitude to maintain, adjust your flight path to avoid the areas, or contact the appropriate authority for permission to fly over.

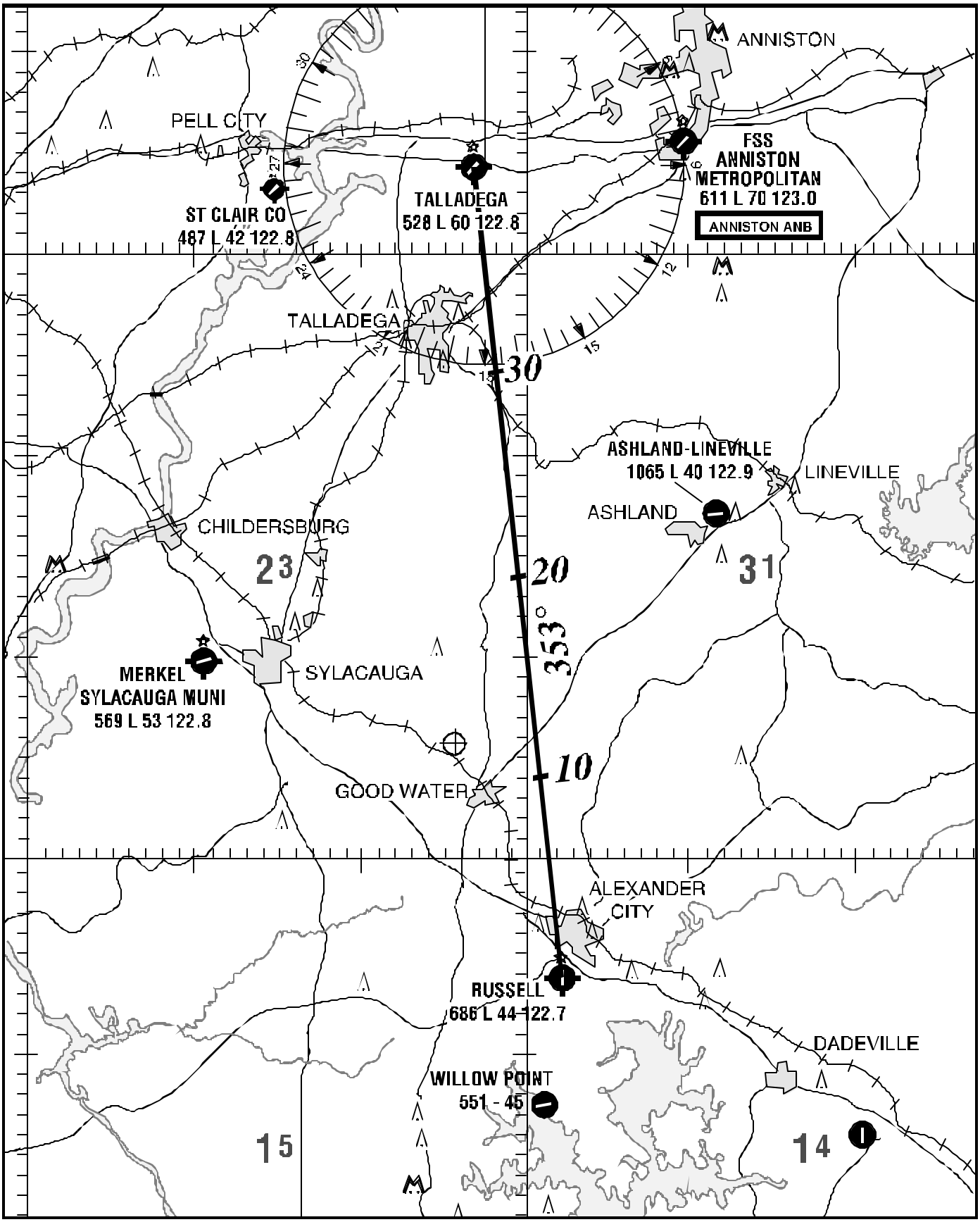
Finally, familiarize yourself with other pertinent information on the chart, such as radio frequencies along your route of flight.

PLANNING YOUR FLIGHT ROUTE

As you learned previously in *Map Reading*, planning a route includes the four elements of navigation: position, direction, distance, and time. Refer to the illustration of the appropriate part of the Atlanta Sectional Chart on the next page as you read about planning your route.

1. Position is a point that you can identify. In this case, you locate the positions of your departure and destination points, specifically Russell Airfield outside Alexander City and Talladega Airport north of Talladega.

Illustration 4.1.3



2. Direction is the position of one point in relation to another without reference to the distance in between them. On your chart, you draw a line between Russell Field and Talladega Airport, then figure direction using an air navigation plotter (below). The plotter consists of a protractor with direction scales and a straight edge. Using this tool, you figure your course from Russell Field to Talladega Airport is 353 degrees.

3. Distance is the space between two points measured by the length of the line joining them. You determine distance for your flight by using the scales on the air navigation plotter, or, as you did in previous *Map Reading* lessons, using the graphic or bar scales on your chart. If using the chart scale, you note ten-mile increments from the scale on a piece of paper. Then place the paper along your route. Transfer the ten-mile increments to your chart marking each increment with the mileage. Your straight-line distance is 40 miles.

4. Time is an elapsed interval. Your aircraft cruises at 120 mph or 2 miles per minute. To determine your flight time enroute, divide 40 miles by 2 miles per minute and you get 20 minutes. Add a few minutes for climbing and reaching cruising speed, and your flight time from Russell Field to Talladega Airport is about 25 minutes.

As you plan your route, familiarize yourself with the locations of other airports or airfields in case you need to make an emergency landing. Look for alternate routes. Identify **linear features** that you can follow. Pinpoint landmarks along your route against which you can cross-check your position.

CHECKING THE WEATHER

After planning your flight route, call the Federal Aviation Administration (FAA) Flight Service Station (FSS) or the National Weather Service (NWS) for a preflight weather briefing tailored to your specific flight. Your local

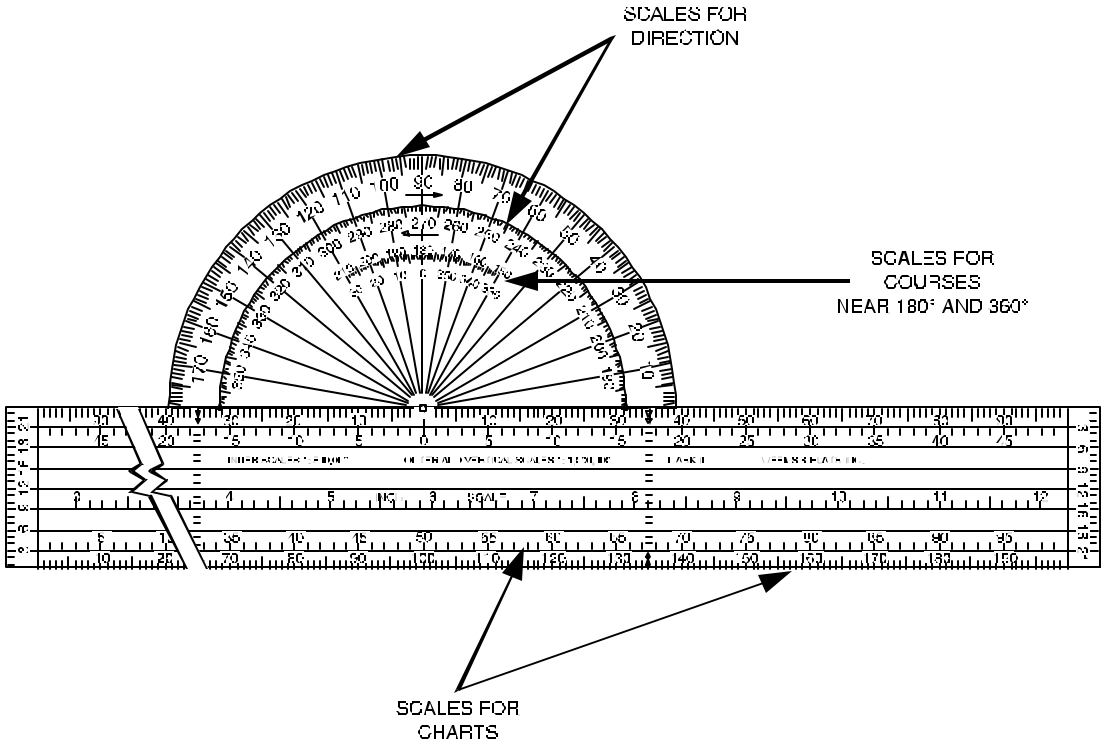


Illustration 4.1.4

phone directory lists FSS and NWS telephone numbers in the U.S. Government section. You will receive current reports and forecasts for departure, enroute, and destination weather, as well as winds at flying altitude and pilot weather reports. For the day you plan to fly to Talladega, you learn that the forecasted weather is good. Winds will be light so they will not affect your flying time.

CHECKING THE AIRCRAFT

You are familiar with your chart, you have studied your route, and you have clear skies. You proceed to your aircraft and perform preflight checks. Everything is in order.

FILING A FLIGHT PLAN

In this scenario, since you are traveling in good visibility, the FAA does not require you to file a flight plan. Understand, however, that the FAA highly recommends a flight plan for all flights regardless of visibility. It lets the proper authorities know your intentions in case of an emergency or if you are overdue at your destination. A flight plan contains your name and address, aircraft description, airspeed, departure and destination points, cruising altitude, and departure and arrival times.

Recording time on your flight plan in this situation is straightforward — you are only flying a short distance north of your present position. However, if you fly far enough east or west of your position, recording time becomes a factor. Unlike ground travel, especially on foot, you travel faster and farther when flying. Therefore crossing time zones becomes a concern.

Before the establishment of time zones in 1883, every city and town had their own time, which led to much confusion. An international convention designated that the **prime meridian**, or 0 degrees longitude, pass through the Royal Observatory at Greenwich, England. This established **Greenwich Mean Time**, the time of day at any given moment in Greenwich, England.

Since the earth rotates 360 degrees in 24 hours, you can divide the equator into 360 degrees or 24 hours. Each hour represents 15 degrees of longitude, and every 15 degrees of longitude, measured from the prime meridian, represents a time zone. Certain populated areas that are divided into two time zones have kept the time of one or the other zone to avoid confusion. You can see this in the illustration of U.S. time zones on the next page.

As a pilot, you have several options when giving your Estimated Time of Arrival (ETA) on a flight plan. For example, if you were to fly from Alabama east into Georgia, intending to arrive at 10 o'clock in the morning your time, you could give 1000 as your ETA and indicate that it is Central Standard Time (CST). Or, since you know that Georgia is in the Eastern Standard Time (EST) zone and it is one hour later there, you could give your ETA as 1100 EST. Another commonly used way to indicate your arrival time would be to use Greenwich Mean Time (GMT) or ZULU time. In this case, you would give your ETA as 1600 GMT or ZULU.

THE FLIGHT

With your preflight complete and your departure time at hand, you takeoff on your flight. As in orienteering, the compass on board your aircraft indicates your direction. Like the speedometer in your car, the airspeed indicator informs you of your speed. Unique to flight, the **altimeter** measures your aircraft's altitude. Throughout your trip, check your instruments to ensure you are on track with your planned direction, speed, and altitude.

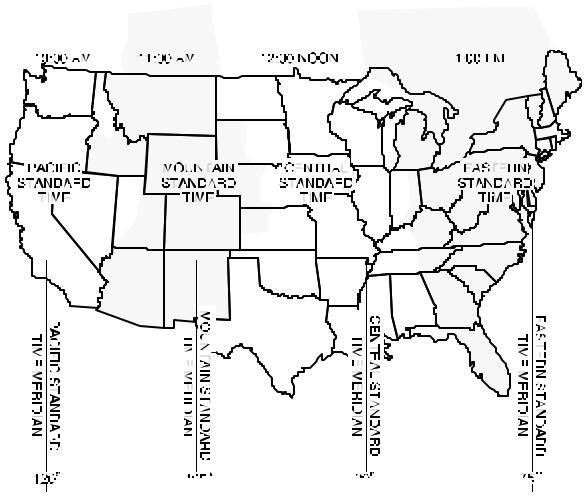


Illustration 4.1.5

The Global Positioning System (GPS) is a high-tech worldwide radio-navigation system formed from a network of 24 satellites and their ground stations. GPS provides precise air navigation and landing systems. This technology makes flying safer, and more efficient. GPS provides the most direct air route for pilots, which saves time and fuel. In addition, the accuracy offered by GPS allows planes to fly closer together on more direct routes. This in turn means that more aircraft can occupy airspace. The benefits of time and fuel efficiency are wide-ranging.

Fly safe. Whether you are hiking, driving, or flying, getting lost or caught in bad weather is no fun and may even put you in an unsafe situation. Proper execution of your predetermined route requires your complete attention, especially when you are in the air. Running out of gas in your car is an inconvenience; running out of fuel in the air can be life threatening. Likewise, traveling at night or in bad weather on the ground requires caution, but you should never fly at night or in bad weather if you are not night-qualified or instrument-certified. If you find yourself running low on fuel, or darkness or bad weather is approaching, do not hesitate to land at the nearest suitable airfield.

Once you learn the basics of pilotage, it is not too complicated to get from here to there in the air. Just pay attention, maintain course and keep track of elapsed time. Along your route, follow the landmarks that you noted on your chart during preflight. Cross-check your position using the features below. First note that you fly directly over Alexander City after takeoff. Since you are flying two miles per minute or ten miles per five minutes, make sure you are on schedule by checking the time against the ten-mile increments marked along your route. For example, within about five minutes into your flight, check that the little town of Good Water is off to your left. Then, as you pass Talladega on your left at the 30-mile marker, check that you are 15 or 20 minutes into your flight. Continue your trip in this fashion, and you will be landing safely as planned.

CONCLUSION

In a plane, you can travel much farther and faster than you can on the ground; and from the air, your perspective broadens as miles of the earth unfold beneath you. This lesson has familiarized you with air navigation charts, preflight, and flight execution. Whether you become a pilot someday or simply travel as an airline passenger, having a basic understanding of air navigation will be helpful in our fast-paced, ever-moving world.

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